

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

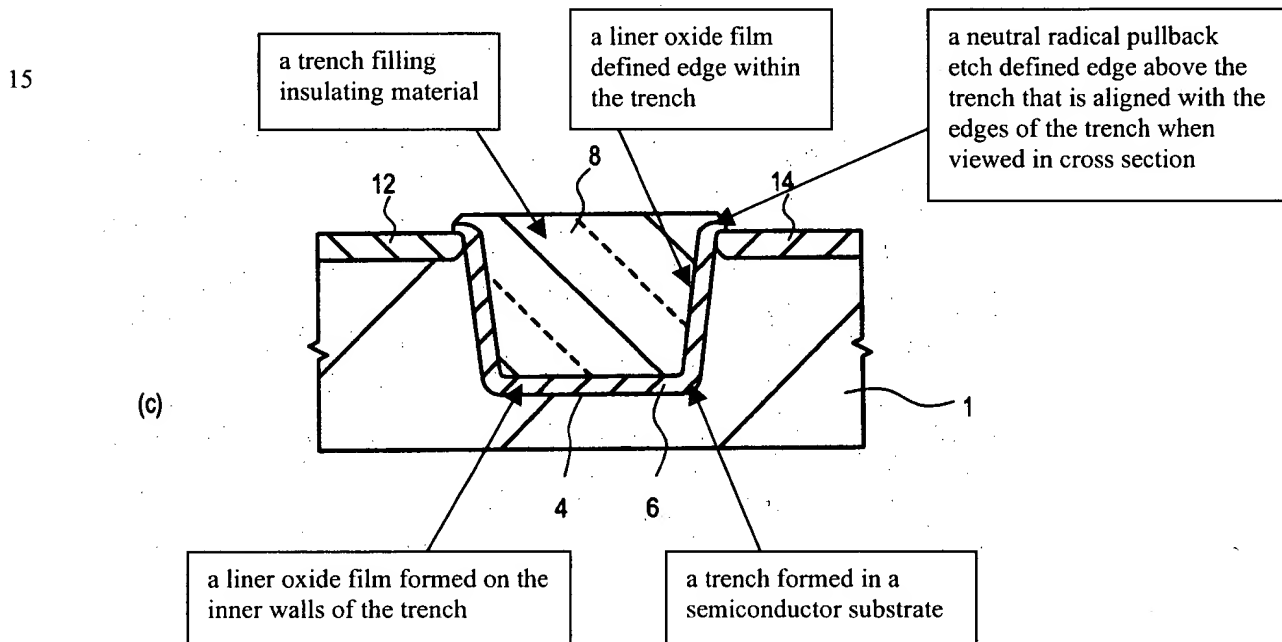
D. Remarks

Restriction Requirement.

5 Provisional Election with Traverse.

Applicant provisionally elects the species of FIGS. 1(a) to 2(c), 3 and 6 with traverse. Further, claims 22-25 are provisionally identified as readable upon this species.

The rejection argues that new claims 22-25 are directed to an intermediate structure of FIG. 1(d), which is patentably distinct from the final structure of FIG. 2(c). Applicant respectfully disagrees. All the language of independent claim 22 (as amended, and prior to being
10 amended) finds clear support in FIG. 2(c). This is illustrated below, in the documented version of FIG. 2(c).



20 Of course, the above interpretation represents but one reading of claim 22 on an embodiment, and should not be construed as limiting to the scope of claim 22.

Because the elements of claim 22 are all found in the final structure of FIG 2(c), claim cannot be directed to a different species. For this reason, this ground for rejection is traversed.

Additionally, Applicant's note that claim 22 has been amended to more clearly relate

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claims 22-26 to the invention originally claimed. In particular, claim 22 has been amended to include the isolation feature of the structure, which was previously included only in the preamble.

The following comparison between the language of original claims 1-11 and newly submitted claim 22 is believed to also show that claim 22 presents a distinct and independent invention with respect to the original invention of claims 1 and 4.

Original Claims 1 and 4	New Claim 22
a trench element separation region including a trench formed in a surface of a semiconductor substrate, the trench element separation region isolating separate semiconductor elements	a trench formed in a semiconductor substrate that isolates separate semiconductor elements
an oxide film formed on inner walls of the trench;	a liner oxide film formed on the inner walls of the trench; and
a trench filling insulating material filling the trench and having edges above the inner walls of the trench; and	a trench filling insulating material within the trench having a liner oxide film defined edge within the trench, and
wherein a top section of the trench and the edges of the trench filling insulating material are formed so as to be essentially located on the same plane	a neutral radical pullback etch defined edge above the trench that is aligned with the edges of the trench when viewed in cross section
the side edges of the sacrificial layer are formed by an etching process including a neutral radical	

For all of the above reasons, the restriction requirement for claims 22-25 is traversed.

In light of the above, Applicant respectfully requests a reconsideration of the election requirement pursuant to CFR §1.143 to thereby establish right of petition on this matter.

Rejections Under 35 U.S.C. §112, First Paragraph.

To address this rejection, Applicant believes a clarification of the figures is helpful.

Importantly, FIG. 6 is a magnified view of edge formed in FIG. 2.

FIG. 6 and FIG. 7 are cross-sectional views of a trench element separation region
after the N-type (P-type) diffusion layers described in FIG. 2 are formed.¹

As explicitly noted in the next four paragraphs of the Specification, FIG. 6 shows an edge
according to the invention, while FIGS. 7(a) and 7(b) shows drawbacks of conventional methods.

As seen in FIG. 6 below, an oxide film 6 extends essentially only horizontally and is
formed below and terminates beyond the edges of the trench insulating material above the inner
walls. Of course, the below diagram is but one particular example of a reading of the claim 21,
which shows clear possession of the invention of claim 21. Claim 21 should not be limited
thereto.

The edge of oxide film 6 is formed when forming the oxide film 6 in the trench. When
the trench is formed, recessed sections 5 may be formed by etching.² It is noted that these
recessed sections 5 extend beyond the inner walls of the trench, which essentially define the
edges of the trench filling insulating material above the inner walls of the trench in claim 1.

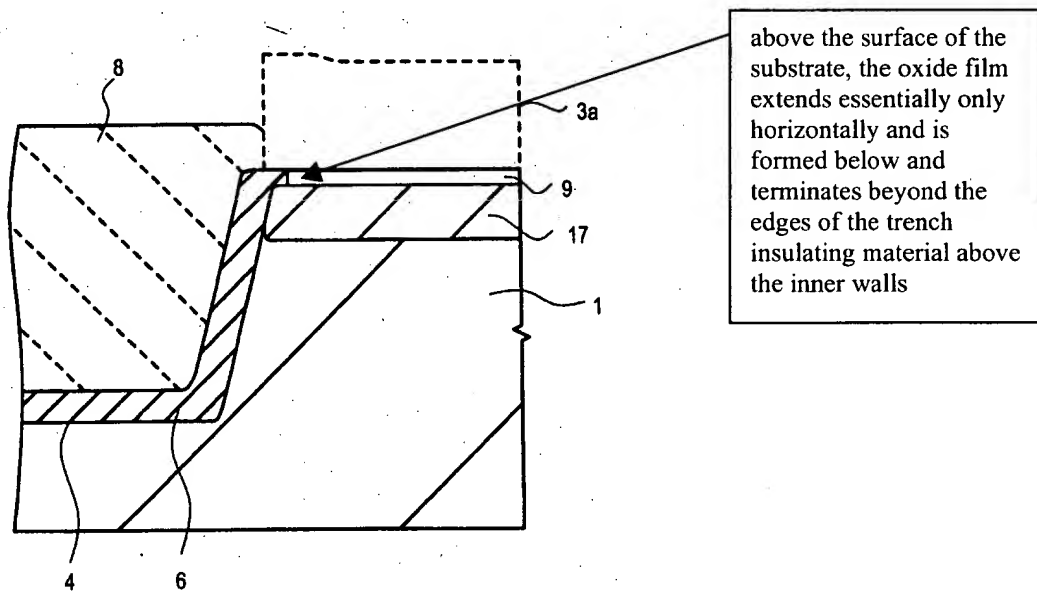


FIG. 6

¹ See Applicant's Specification, Page 19, Lines 13-15.

² See FIGS. 1a and 1b in conjunction with page 12, lines 22 to page 13, line 5 of the specification, which give but one example of forming the edge of the oxide film 6 beyond the edges of the trench and therefore the edges of the trench filling insulating material above the inner walls.

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From the above, the Specification is believed to provide clear support for the limitations of claim 21, and this ground for rejection is traversed.

Rejection of Claims 1, 3, 5-7, 9, 11 and 21 Under 35 U.S.C. §102(e) or §103(a) based on
5 *Ishitsuka et al.* (U.S. Patent No. 6,242,323).

The rejection of claims 1, 3, 5 and 21 will first be addressed.

The invention of claim 1 is directed to a semiconductor device that includes a trench element separation region including a trench formed in a surface of a semiconductor substrate. The trench element separation region isolates separate semiconductor elements. An oxide film is
10 formed on inner walls of the trench. A trench filling insulating material fills the trench and has edges above the inner walls of the trench. Inner wall edges in a top section of the trench and edges of the trench filling insulating material are formed to be essentially located on the same plane when viewed in cross section.

Unlike conventional approaches disclosed in Applicant's Specification, and unlike the
15 cited reference *Ishitsuka et al.*, the edges of the trench filling material are defined by direct contact with side edges of a sacrificial layer formed by a pullback etching process including a neutral radical performed for the trench filling process.

Applicant acknowledges the rejection's interpretation of the above emphasized claim language as presenting a product-by-process limitation. Applicant also acknowledges that
20 obviousness in such a case depends upon the patentability of the resulting structure, and further, the burden of showing the unobviousness of the structure switches to the Applicant.

However, Applicant believes sufficient evidence has been presented to show that the resulting claim 1 structure is not obvious. These differences will be described and documented below.

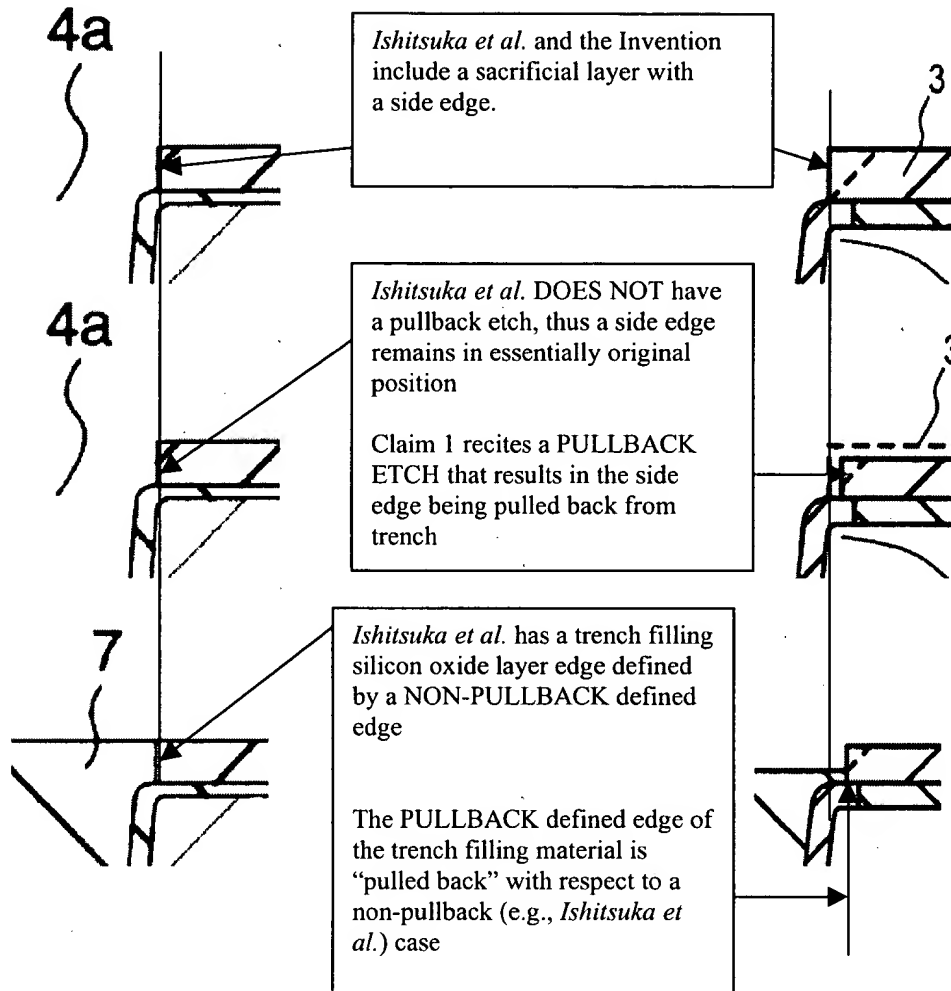
25 *Ishitsuka et al.* does not show or suggest a trench filling material edge defined by a side edges formed by a pullback etching process. *Ishitsuka et al.* provides no teachings regarding a pullback etch defined edge. The resulting structural difference results.

Ishitsuka et al.

(FIGS. 16 and 19)

Specification

(FIGS. 1(a) to 1(d))



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10 The above is believed to clearly show a structural difference between the cited reference and the claimed invention. Of course, it is understood that Applicant's reference to FIGS. 1(a) to 1(c) of the Specification represents but one particular illustration of the limitations of claim 1.

Thus, Applicants claim 1 invention includes limitations not shown in *Ishitsuka et al.* Accordingly, the reference cannot anticipate claim 1.

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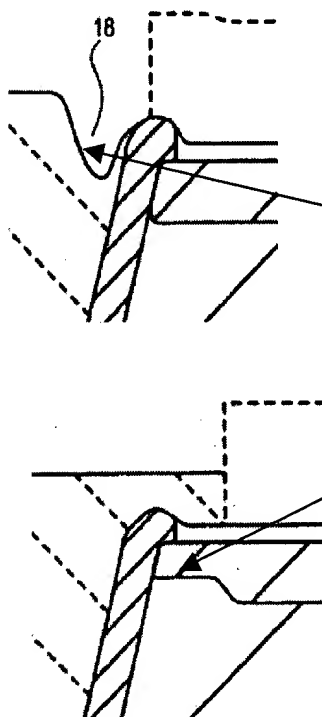
Still further, because *Ishitsuka et al.* is silent as to any modification of the edge of a silicon nitride sacrificial layer, the reference is not suggestive of such a limitation. Accordingly, because the cited reference does not show or suggest all limitations of claim 1, the reference cannot establish a prima facie case of obviousness.

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For these reasons alone, this ground for rejection is traversed.

In addition, Applicant adds that claim 1 does not simply recite an edge defined by a pullback etch process, but rather an edge defined by a pullback etch process that includes a neutral radical. Such a limitation adds even further structural differences between the cited reference and the invention.

Specification
(FIGS. 7(a) and 7(b))

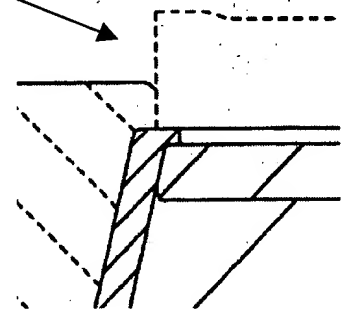


The present invention may enable high accurate etching of the silicon nitride film 3 by the pullback process... (Specification, Page 20, Lines 1-2)

[I]n the conventional method... etching control of silicon nitride film 3 can be difficult... the amount of etching of the silicon nitride film 3 can be low... a cavity 18 may be formed... (Specification, Page 20, Lines 11-15)

[W]here the amount of etching of the silicon nitride film 3a is high... an uneven diffusion layer 17a can easily form... (Specification, Page 10, Lines 18-21)

Specification
(FIG. 6)



Thus, Applicant's claim 1, by reciting an edge defined by a pullback etch process that includes a neutral radical, recites a further structural difference over conventional cases (both *Ishitsuka et al.*, as well as the Background Art): a more precise positioning of a sacrificial layer edge, and hence a more precise positioning of a trench filling material edge are defined by such a sacrificial layer edge.

Thus, the cited reference fails to show this limitation as well. Because *Ishitsuka et al.* remains silent as to a pullback etch, the reference cannot be suggestive of such a limitation either.

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The rejection of claims 7, 9 and 11 will now be addressed.

Claim 7 is directed to a semiconductor device that includes a trench formed in a surface of a semiconductor substrate. The trench element separation region isolating a first doped channel layer of a first insulated gate field effect transistor (IGFET) from a second doped channel layer of a second IGFET. Also included are an oxide film formed on inner walls of the trench and a trench filling insulating material filling the trench.

The trench filling insulating material has edges above the inner walls of the trench defined by direct contact with side edges of a sacrificial layer formed by a pullback etching process including a neutral radical performed before filling the trench. The inner wall edges in a top section of the trench and the edges of the trench filling insulating material are formed so as to be essentially located on the same plane when viewed in cross section

To address this ground for rejection, Applicant incorporates by reference the same general arguments set forth above for claim 1. Namely, that the reference does not show or suggest the structural limitation of a side edge “defined by direct contact with side edges of a sacrificial layer formed by a pullback etching process including a neutral radical”.

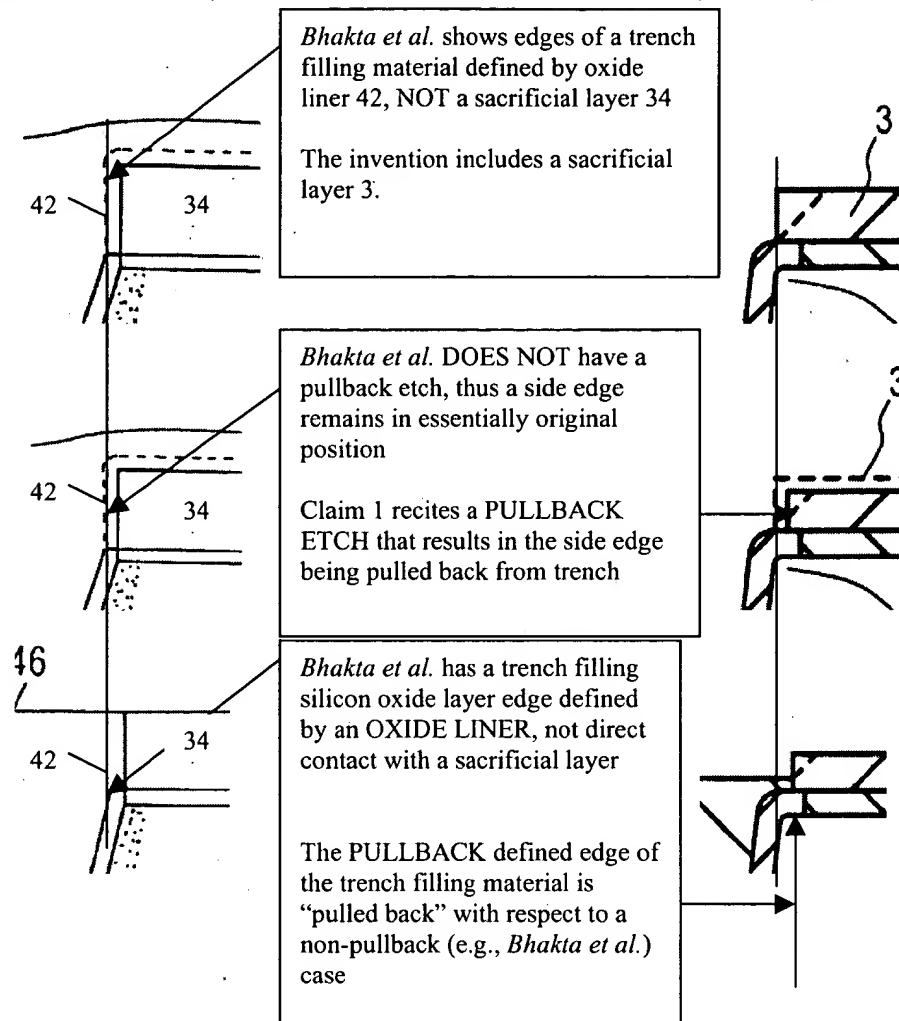
Rejection of Claims 7, 9 and 10 Under 35 U.S.C. §102(e) or §103(a) based on *Bhakta et al.* (U.S. Patent No. 6,258,697).

As in the case of the reference *Ishitsuka et al.*, Applicant believes sufficient evidence has been presented to show that the resulting claim 7 structure is not obvious. These differences will be described and documented below.

Like *Ishitsuka et al.*, *Bhakta et al.* does not show or suggest a trench filling material edge defined by a side edges formed by a pullback etching process. *Bhakta et al.* provides no teachings regarding a pullback etch defined edge. The resulting structural difference results.

Bhakta et al.
(FIGS. 3D and 3G)

Specification
(FIGS. 1(a) to 1(d))



The above is believed to clearly show a structural difference between the cited reference and the claimed invention. Of course, it is understood that Applicant's reference to FIGS. 1(a) to 1(c) of the Specification represents but one particular illustration of the limitations of claim 1.

Thus, Applicants claim 7 invention includes limitations not shown in *Bhakta et al.* Accordingly, the reference cannot anticipate claim 7. Because *Bhakta et al.* is silent as to any modification of the edge of a silicon nitride sacrificial layer, the reference is not suggestive of such a limitation.


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Claim 22 has been amended, not in response to the cited art, but to incorporate limitations of the preamble into the body.

The present claims 1, 3, 5-7, 9-11, 21-25 are believed to be in allowable form. It is respectfully requested that the application be forwarded for allowance and issue.

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Respectfully Submitted,

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Darryl G. Walker

Attorney

Reg. No. 43,232

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Darryl G. Walker
WALKER & SAKO, LLP
300 South First Street
Suite 235
San Jose, CA 95113
Tel. 1-408-289-5314

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